The Indiana Bat: How to Manage Missouri Department of Conservation Forests for an Endangered Species

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Need

The Indiana Bat is a federally listed Endangered Species found throughout much of the eastern U.S. Range wide, Indiana Bat populations have declined about 60% since surveys began in the 1960s. In Missouri, Indiana Bat populations have declined more than 80% since 1983. Known causes of decline include disturbance and vandalism during hibernation, as well as harmful alterations of hibernation caves (improper gates and microclimate changes). Many of the caves in which Indiana Bats hibernate have been protected, but populations have continued to decline despite these efforts. Other, suspected causes of decline include chemical contamination, conversion of large expanses of native vegetation to agriculture, and forest fragmentation. Studies are underway to better understand Indiana Bat ecology and the reasons for the drastic population declines. While we may not yet have all the answers to our questions, the information we have learned about roosting and foraging habitat can be applied and well may enhance the survival of the Indiana Bat during the non-hibernation seasons of the year.

In Missouri, Indiana Bats hibernate in caves in the Ozarks. Evidence suggests that most females migrate north for the spring and summer, where they form maternity colonies of up to 100 bats. Male Indiana Bats may roost singly or in small groups during summer; some males may be found with females in maternity colony areas, although others remain near their hibernation caves. Indiana Bats consistently return to their colony areas, and sometimes individual roosts, each year.

During summer, Indiana Bats can be found in a wide range of habitats. Although summer needs are not yet fully understood, some forest is necessary. Forest cover can vary from 5% to 100%; ideal may be 30-60% in the maternity range. In reality, most of Missouri may be potential summer habitat for Indiana Bats, with north Missouri regarded as core maternity range and south Missouri occupied by male bats, although some maternity colonies occur there, as well.

A revised recovery plan is being drafted by the USFWS. This plan may contain information and recommendations that can be used by MDC land managers to protect and enhance Indiana Bat habitat on Missouri Department of Conservation lands. An understanding of elements of this plan can also help staff avoid inadvertently violating the Endangered Species Act "take" regulations. (Take under the Act may occur when someone kills, harms, or harasses an endangered species.)

Active forest management in Indiana Bat habitat has been controversial, especially on public land. Despite the controversy surrounding this species, with proper awareness and planning, forest managers can avoid harming Indiana Bats and even enhance Indiana Bat habitat on public and private land.

The information provided below is excerpted from the revised recovery plan and provided here in synopsis form. For additional information or a copy of the revised recovery plan (after it is finalized), please contact the Endangered Species Coordinator (Peggy Horner) or MDC's Indiana Bat Recovery Leader (Tony Elliott).

Some Specifics about Habitat

Roost Trees

- Indiana Bats, whether in maternity colonies or roosting singly, primarily roost under the loose bark of dead trees (see Figure 1for examples.) Crevices and cavities also are used, but to a much lesser extent. Some live trees (including shagbark, shellbark hickory, and white oaks >20"dbh) also may be used as roosts, but in far fewer numbers than dead trees.
- The physical structure (dead tree/loose bark) is more important than the species of tree.
- Indiana Bats use multiple roosts throughout a summer season. A maternity colony will have at least one primary roost (large dead tree with a large degree of solar exposure) and a number of secondary roosts (over 20 roost trees have been found for one colony).
- Primary maternity roost trees average 18" dbh and male roost trees average 13" dbh.
- For most roosts, sunlight striking the bark where the bats are roosting is important. As a result, most roosts are found in the open, at forest edges, or high in a tree. During periods of rain or high temperatures, however, Indiana Bats may roost in trees surrounded by canopy, or in living, shaggy-barked hickories and white oaks greater than 20" dbh.
- Indiana Bats roost in standing trees; none have been found in down trees.
- In north Missouri, Indiana Bats roost throughout the landscape, from the riparian corridor all the way up the slope to the uplands.
- In the Ozarks, Indiana Bats may prefer to roost in snags with greater solar exposure on upper slopes and ridge tops, but have also been found in riparian areas.
- Roost trees are ephemeral (the bark sloughs off or fall down); therefore, a continuing supply is needed.
- Indiana Bats commonly move from roost to roost probably in response to environmental factors (rain and high temperatures) and to locate alternate roosts in the case of loss of a roost tree.
- Disturbance (i.e., timber harvest, windthrow, fire, tornadoes) can create suitable roost trees

Food Habits and Foraging Habitat

- Indiana Bats forage on flying insects. They tend to forage among and adjacent to tree canopies. The insects that they eat will reflect what is available where they forage, i.e., in riparian areas both aquatic and terrestrial prey will be taken; in uplands, terrestrial insects, especially moths, will predominate.
- In north Missouri, Indiana Bats usually forage in riparian and floodplain forest, but also may use upland forest, edges, old fields, and over ponds.
- In south Missouri, Indiana Bats primarily forage in upland and ridge top forest.

Management Recommendations:

Statewide Forest Management

The following recommendations are designed to provide Indiana Bat roosting and foraging habitat on state-managed forest lands throughout Missouri:

Either even-aged management (EAM) or uneven-aged management (UAM) may be used to manage the forest; both may be used to create or maintain potential Indiana Bat habitat. Within a management compartment, manage to preserve or create a diversity of age and size classes, with mature and over-mature trees well represented. These latter trees, as they die and become snags, will provide a continuing supply of potential roost sites for Indiana bats. In EAM harvests, it is important to follow snag retention guidelines and to retain live trees/groups to provide suitable roosting habitat in the future.

Salvage Cuts: Salvage harvests should be performed before trees become suitable roosting sites. If the bark is still tight (be aware of cavities or large branches with loose bark that could serve as roost sites), salvaging dead and dying trees due to decline or disease is not a threat to the Indiana Bat. Also, consider leaving pockets of dead and dying trees as future sources of suitable roost trees. Trees that have fallen to the ground may be salvaged regardless of bark conditions.

While conducting normal forest management duties including inventory, timber stand improvement, marking timber or during harvesting operations when multiple bats are observed on or flying from a standing dead tree with loose bark, staff shall stop any activities involving tree cutting until a 100 foot buffer is designated around the tree.

- Contact supervisors with the information.
- Contact the appropriately trained staff to evaluate the tree as an Indiana Bat maternity roost.
- If the tree is confirmed to be an Indiana Bat maternity tree it shall be marked and GPS coordinates recorded.
- Maintain the 100 foot radius no-cut buffer around any known, currently active Indiana Bat primary maternity roost trees from May 1 through August 31.

Take precautions to avoid felling or damaging any known Indiana Bat maternity roost tree at any time. If a known maternity roost must be cut, remove it during the hibernation season (October 1 – March 31). Mitigate for the loss of this habitat by creating additional large snags, if there are no remaining snags left in the immediate area.

During harvest, leave snags wherever found except where a safety hazard or in a salvage harvest; retain some in groups with live trees to prevent wind-throw. Manage forested acres for at least the minimum number of snags as shown in Table 1 (modified from MDC 1985 Management of snag and cavity trees in Missouri, Habitat management series No. 2). Favor oaks, hickories, and ashes for retention or snag creation where choices are possible. (Cavity trees may be used only to a limited extent for roosting by Indiana Bats, but are often used by

other species. Snags are emphasized in these guidelines, but cavity trees should be included in the leave tree component of a stand: one cavity tree per acre, if available.)

Table 1. Recommended minimum number of snags per acre by forest type.

	Number of Snags per Acre		
Forest Type	**>19" dbh**	**10"-19" dbh**	**<10" dbh**
Heavily Forested	0.5	4	2
Open/Semi-Open	1	4	2
Riparian Corridor	1	7	4
Bottomland Hardwood	1	4	2

Woodland: Manage woodlands on appropriate sites to perpetuate hardwoods or a mixture of hardwoods and pine. The openness of the canopy (20-80%), a low amount of understory, and herbaceous composition of the ground flora should be a highly beneficial for most of the bats of Missouri, including the Indiana Bat. Summer burns in woodlands could negatively affect Indiana Bat maternity colonies that may be present. If possible, conduct burns outside of the main maternity season (May 1 through August 31).

Bottomland forest: Manage to perpetuate hardwoods with a diversity of tree species and age classes. Use small clear cuts (no larger than 25 acres and be sure to follow MDC's guidelines for management in riparian zones) or UAM (group or single tree selection) to create a mixture of mature and over-mature trees in groups within stands, as well as small openings in the canopy. The goal is to develop patchiness, vertical height diversity, and dead/dying trees and snags to provide roosts and foraging habitat for bats.

Riparian Corridors: Manage to perpetuate a diversity of tree species and age classes. Maintain a forested buffer strip on each side of perennial streams; 100 ft has been adopted as a minimum width, but wider is better if the topography and hydrology are suitable (2006 MDC Management Guidelines for Maintaining Forested Watersheds to Protect Streams). Reforestation should occur on lands lacking minimum forest corridors. Maintain a minimum of 10 contiguous acres of old growth surrounding caves and springs.

Additional Forest Management Considerations South of the Missouri River

In regions with large areas of contiguous, mature canopy, forest management practices that open the canopy and reduce understory may enhance Indiana bat roosting and foraging habitat. Reducing the canopy from a solid, 100% coverage into the range of <80% but >30% would create openings and edges where snags would receive sunlight, thus improving them for roosting. Reduced canopy also would create foraging habitat, because Indiana bats forage around and adjacent to tree crowns. Reducing the understory would make snags more accessible by removing obstacles to flight, allow sunlight to strike the snags, and allow the bats to forage beneath the tree canopy. Savanna and woodland management may supply some or all of these conditions and should be applied on appropriate sites within the landscape.

If not available, provide water sources (ponds, ephemeral pools, etc.) to enhance Indiana bat habitat. Site them along ridge tops, approximately $^1/_2$ mile apart.

Target upper slopes and ridge tops for snag retention and development; retain adequate snag densities in riparian areas.

Designate old growth around Indiana Bat hibernation caves. Twenty acres is recommended, but incorporate topography, watershed, etc. considerations into the old growth design, size, and configuration to protect the integrity of the cave system. In addition, manage the site to provide forested connections between the cave and potential foraging areas.

Within 5 miles of known Priority 1 and Priority 2 hibernacula (see Table 2):

1) Designate a minimum of 10% of forest in each compartment as old growth. Old growth and leave stands can provide large snags in the future through natural mortality.
2) Maintain or create a balanced age-size class distribution through EAM or UAM methods.
3) To avoid the potential for direct take, harvest should not occur during swarming and staging periods (Sept 15 – Nov 1 and Mar 15 – April 30). Be aware that males and non-reproductive females may stay around hibernacula during the summer.
4) Retain snags as found or when necessary create the recommended number of snags in any treated stand: In a clear cut, TSI, or intermediate cut, retain or create the recommended number of snags per acre.
5) In seed tree or shelterwood cuts, defer harvest of residual trees for one or more extra entry periods to provide foraging habitat.
6) Protect the integrity of cave recharge areas and sinkholes (see *Cave and Karst Management* section of Chapter 6 in the FLAG).

Campgrounds and River Accesses - Small Scale Projects (Hazard Tree Removal)

The open canopy, savanna-type forest structure in and around many MDC campgrounds and access areas may be prime habitat for Indiana Bats in both north and south Missouri. Given our policy of removing dead trees for safety purposes, special consideration should be given to the possibility of encountering Indiana bats, especially maternal roost sites. The best way to make sure that Indiana bats are not roosting in a tree when it is removed is to cut trees during the winter months when Indiana bats are hibernating in caves, between 1 October and 31 March. If tree removal becomes necessary outside the above time frame, potential roost trees should be examined carefully to ensure that no Indiana bats are using a tree as a roost when it is cut. If a tree must be removed between 31 March and 1 October and is determined to be an Indiana bat roost tree, we will enter into formal consultation with the U.S. Fish and Wildlife Service. For specific guidance, contact the Endangered Species Coordinator (Peggy Horner) or MDC's Indiana Bat Recovery Leader (Tony Elliott).

Table 3 provides a summary of dates to avoid specific activities.

Table 2. MDC region, survey frequency, and level of protection for Indiana bat hibernacula in Missouri.

Cave	County	Owner	MDC Region	Survey Frequency	Current Protection
Rocheport (Boone)	Boone	MDC	Central	Biennial	Fence
Devil's Icebox[2]	Boone	DNR	Central	Biennial	Sign
River	Camden	DNR	Central	Quinquennial	Gate
Kelly Hollow	Oregon	USFS	Ozark	Quinquennial	--
White's Creek	Oregon	USFS	Ozark	Biennial	Gate
Brooks[2]	Pulaski	US Army	Ozark	Biennial	Sign
Davis No. Two	Pulaski	US Army	Ozark	Quinquennial	--
Great Spirit[2]	Pulaski	MDC	Ozark	Biennial	Gate
Joy	Pulaski	US Army	Ozark	Quinquennial	--
Piquet[2]	Pulaski	Private	Ozark	Quinquennial	--
Ryden[2]	Pulaski	MDC	Ozark	Biennial	Gate
Bat[1]	Shannon	TNC	Ozark	Biennial	Fence
Big	Shannon	Pioneer Forest	Ozark	Quinquennial	--
Cookstove[2]	Shannon	Pioneer Forest	Ozark	Biennial	Gate
Martin No. One[2]	Shannon	NPS	Ozark	Biennial	Gate
Powder Mill[2]	Shannon	MDC	Ozark	Biennial	Gate
Dunvin[2]	Texas	Private	Ozark	Quinquennial	--
Onyx[2]	Crawford	DNR	St. Louis	Biennial	Gate
Bear[2]	Franklin	DNR	St. Louis	Biennial	Gate
Copper Hollow Sink[2]	Franklin	DNR	St. Louis	Biennial	Sign
Tyson Quarry	St. Louis	Washington U.	St. Louis	Quinquennial	--
Great Scott[1]	Washington	MDC	St. Louis	Biennial	Gate
Hamilton[2]	Washington	DNR	St. Louis	Biennial	Gate
Scotia Hollow[2]	Washington	MDC	St. Louis	Biennial	Gate
Cave Hollow	Iron	USFS	Southeast	Biennial	Gate
Pilot Knob[1]	Iron	USFWS	Southeast	Biennial	Fence
Mary Lawson[2]	Laclede	MDC	Southwest	Biennial	Gate
Slaven[2]	Laclede	Private	Southwest	Biennial	--

[1] Priority One hibernaculum (population >30,000 since 1960)
[2] Priority Two hibernaculum (population >500 but <30,000 since 1960)

Table 3. Summary of dates to avoid specific forest management activities in relation to Indiana bat habitat.

Dates to Avoid	Management Activity
May 1 through August 31	Any management within 100ft. radius of known currently active Indiana bat primary maternity roost tree
May 1 through August 31	Woodland burns without sufficient justification
April 1 through September 31	Felling or girdling any known active Indiana bat roost tree
April 1 through September 31	Removal of hazard trees that are potential roosts without examination for possible Indiana bat roost status
September 15 through November 1 and March 15 through April 30	Extensive felling or girdling activities within 5 miles of known Priority 1 or 2 Indiana bat hibernacula (Table 2)

Figure 1. Examples of Indiana bat roost trees.